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**SOLAR OBSERVATIONS****SOLAR RADIATION MEASUREMENTS DURING NOVEMBER 1935**

By IRVING F. HAND, Assistant in Solar Radiation Investigations

For a description of instruments employed and their exposures, the reader is referred to the January 1935 REVIEW, page 24.

Table 1 shows that solar radiation intensities averaged close to normal at Washington for November and above normal at both Madison and Lincoln.

Table 2 shows a deficiency in the amount of total solar and sky radiation at all stations with the exception of Lincoln, Chicago, New York, New Orleans, and Riverside. Beginning with November, departures from normal will regularly be published for Blue Hill, Mass., as sufficient measurements have now been obtained to establish normals.

In table 3 the values of water vapor determined from the observations at 0:48 and 0:44 hour angle on the morning of November 18 show markedly the necessity for not only very clear skies for good determinations, but also precise instrumental measurements. In this 4-minute interval the radiation increased less than 3 percent; yet the value of the water vapor, as determined by this method, decreased 84 percent.

Polarization measurements obtained on 5 days at Washington give a mean of 58 percent with a maximum of 63 percent on the 25th. At Madison, observations obtained on 2 days give a mean of 67 percent with a maximum of 69 percent on the 20th. All of these values are close to the corresponding November normals.

**LATE DATA.**—The values of the total solar and sky radiation received on a horizontal surface during the weeks beginning October 1, 8, 15, and 22 are as follows: Miami; 310, 224, 309, and 378. Blue Hill; 380, 416, 395, and 304.

TABLE 1.—*Solar radiation intensities during November 1935*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance										Local mean solar time				
	8 a.m.		78.7°		75.7°		70.7°		60.0°		0.0°	60.0°	70.7°	75.7°	78.7°
	75th mer. time.		Air mass												
	e.		5.0	4.0	3.0	2.0	* 1.0		2.0	3.0	4.0	5.0	e		
Nov. 8	mm	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm	5.56	
Nov. 9	7.29	0.49	0.58	.76	.97			1.16	0.99					2.62	
Nov. 18	5.56	4.95	.96	1.08	1.26				1.20	1.12	0.97	0.81		6.76	
Nov. 22	4.95	5.36	.59	.70	.78	.97								4.17	
Nov. 25	5.36	2.49			1.18	1.32		1.28	1.04					5.56	
Means	(0.54)	(0.54)	.75	.96	1.14			1.21	1.05	(.97)	(.81)			2.87	
Departures	- .22	- .22	- .12	- .05	- .04			+ .03	+ .05	+ .12	+ .07				

**MADISON, WIS.**

Nov. 1	3.63							1.43						3.90
Nov. 20	2.87							1.32						3.81
Nov. 21	2.74	1.07	1.19											1.68
Nov. 23	1.78	.90		1.22	1.40									1.96
Means	(.98)	(1.19)	(1.22)	(1.40)				(1.37)						
Departures	+ .09	+ .18	+ .08	+ .10				+ .04						

**LINCOLN, NEBR.**

Nov. 1	2.16	1.04	1.12					1.42	1.23	1.13	1.00			3.15
Nov. 5	3.15													6.33
Nov. 7	4.37	.70	.86	1.06	1.28				1.37	1.19	1.01	.86		5.56
Nov. 8	5.18				1.18	1.37			1.38	1.23	1.09	.97		5.36
Nov. 12	2.87								1.42	1.23	1.07	.96		3.81
Nov. 18	5.56	2.36	.95	1.06	1.22	1.42		1.41	1.23	1.11	.98			6.76
Nov. 22	3.15	3.81	.99	1.07	1.19	1.28								4.57
Nov. 29	3.81	3.99	1.06	1.18	1.29									4.75
Nov. 30	3.99	3.96	1.07	1.19	1.36				1.32	1.18	1.08	5.16		
Means									1.40	1.24	1.10	.97		
Departures	+ .05	+ .05	+ .02	+ .01				+ .05	+ .05	+ .05	+ .05	+ .05		

**BLUE HILL, MASS.**

Nov. 3	5.2	1.07	1.20	1.35	1.41			1.41	1.11	0.95	0.80			4.8
Nov. 4	6.5	1.11	1.18	1.27	1.36			1.32	1.01	.75				6.3
Nov. 7	4.2	1.03	1.09											5.2
Nov. 8	6.9								1.20					6.8
Nov. 9	3.6	1.05	1.08	1.12	1.20			1.19	.96	.78	.63			5.2
Nov. 11	11.5					1.00		1.00						11.9
Nov. 14	5.6	.82	.98	1.14	1.30			1.26	.82		.65			5.6
Nov. 19	4.2	1.02	1.07	1.08	1.09			1.09	1.08	.63				4.4
Nov. 21	5.0	1.02	1.07	1.08	1.09			1.09	1.08	.63				5.6
Nov. 25	1.7	.97	1.11	1.26	1.42				1.19	1.07	.80			3.2
Nov. 26	3.2				1.01	1.15					1.01			4.0
Nov. 27	4.6				1.20	1.31								4.4
Nov. 29	7.4					1.15		1.08						5.4
Nov. 30	4.0				1.05	1.06								3.6
Means					1.01	1.10	1.16	1.22		1.19	1.03	1.01	.71	

• Extrapolated.

TABLE 2.—Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface

Week beginning—	Gram-calories per square centimeter																
	Washington	Madison	Lincoln	Chicago	New York	Fresno	Pittsburgh	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	Friday Harbor	Ithaca	San Juan
Oct. 29.....	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Oct. 29.....	133	146	155	148	83	330	238	35	222	326	312	280	331	173	238	125	580
Nov. 5.....	202	123	194	128	118	338	154	47	241	372	360	278	318	171	107	140	596
Nov. 12.....	104	89	67	35	61	236	43	45	141	262	327	112	288	50	89	48	525
Nov. 19.....	204	156	175	136	144	200	150	10	164	231	340	235	237	170	107	169	567
Nov. 26.....	146	86	168	66	84	256	65	9	199	282	313	246	274	132	76	60	497
Departures from weekly normals																	
Oct. 29.....	-113	-38	-82	+2	-91	+14	---	-6	-4	---	-4	+5	+3	-47	---	---	---
Nov. 5.....	-24	-40	-48	+4	-27	+32	---	+7	+29	---	+12	+12	0	-19	---	---	---
Nov. 12.....	-91	-47	-137	-62	-61	-8	+	+17	-25	-26	-129	-16	-116	---	---	---	---
Nov. 19.....	+15	+27	-29	+20	+21	-37	---	-10	+9	+8	+12	-48	+15	---	---	---	---
Nov. 26.....	-20	-38	-18	-18	-21	+38	---	-5	+43	+32	+27	+13	-10	---	---	---	---
Accumulated departures on Dec. 2																	
	-5,537	-8,918	+3,745	+2,604	+6,881	+4,991	---	+1,561	+4,480	---	+7,721	+469	-6,615	---	---	---	---

TABLE 3.—Total,  $I_m$ , and screened,  $I_s$ ,  $I_r$ , solar radiation intensity measurements, obtained during November 1935, and determinations of the atmospheric turbidity factor,  $\beta$ , and water-vapor content,  $w$ —depth in millimeters, if precipitated

## AMERICAN UNIVERSITY, WASHINGTON, D. C.

Date and hour angle, 1935	Solar altitude	Air mass	$I_m$	$I_s$	$I_r$	$\beta I_{m-r}$	$\beta I_{s-r}$	$\beta_{mean}$	$\frac{I_{w=0}}{1.94}$	$\frac{I_{w=0}-I_m}{1.94}$	$w$	Air-mass type	
Nov. 8.....	°	m	gr. cal.	gr. cal.	gr. cal.	0.136	0.082	0.109	51.8	4.5	mm	N <sub>ra</sub>	
3:16 a. m.....	18 10	3.18	0.934	0.754	0.630	.080	.099	.099	53.4	4.8	1.0	1.1	
3:12 a. m.....	18 45	3.10	.961	.754	.630	.118	.080	.110	55.8	4.8	1.2		
2:49 a. m.....	22 00	2.65	1.012	.796	.657	.141	.080	.100	58.8	5.6	1.5		
2:45 a. m.....	22 32	2.60	1.057	.798	.659	.108	.084	.096	67.6	11.8	10.6		
2:28 a. m.....	24 43	2.38	1.103	.863	.680	.106	.030	.068	67.6	11.8	10.6		
2:24 a. m.....	25 12	2.34	1.104	.863	.680	.102	.036	.069	67.6	9.5	6.0		
1:43 a. m.....	26 37	2.02	1.170	.865	.687	.096	.054	.075	68.6	9.5	6.0		
1:38 a. m.....	30 05	1.99	1.171	.865	.687	.094	.056	.075	69.0	9.8	6.6		
0:48 a. m.....	33 34	1.80	1.170	.882	.697	.136	.052	.094	73.0	13.9	35.0		
0:44 a. m.....	33 48	1.79	1.199	.882	.697	.106	.054	.080	69.8	9.2	5.6		
Nov. 18.....	20 16	1.98	1.272	.934	.743	.082	.038	.080	72.6	8.6	4.0	N <sub>ra</sub>	
0:56 a. m.....	30 43	1.95	1.272	.934	.743	.086	.040	.063	72.4	8.4	4.0	N <sub>ra</sub> aloft.	

## Atmospheric conditions during turbidity measurements

Nov. 8. Temperature, 7° C.; wind, NW. 12; visibility, 30 miles; blueness of sky, 5; polarization, 57 percent.

Nov. 18. Temperature, 5° C.; wind, NW. 20; visibility, 50 miles; blueness of sky, 6; polarization, 61 percent.

## BLUE HILL METEOROLOGICAL OBSERVATORY OF HARVARD UNIVERSITY

Nov. 3.....	23 28	2.50	1.344	0.919	0.750	0.016	0.032	0.024	76.3	8.2	5.2	N <sub>ra</sub>
0:36 a. m.....	32 12	1.87	1.415	.960	.775	.025	.054	.040	76.3	4.5	3.3	
3:03 p. m.....	18 23	3.18	1.008	.776	.649	.084	.075	.080	57.3	6.2	3.5	
Nov. 4.....	14 49	3.86	1.192	.844	.720	.011	.023	.017	73.7	15.2	7.8	N <sub>ra</sub>
0:36 a. m.....	31 57	1.89	1.339	.904	.720	.021	.026	.024	80.8	13.9	10.0	
Nov. 9.....	16 49	3.43	1.088	.779	.688	.050	.033	.042	64.1	9.3	5.0	N <sub>ra</sub>
0:43 a. m.....	30 15	1.98	1.205	.823	.725	.095	.075	.085	77.6	8.8	6.3	
3:25 p. m.....	21 43	2.69	1.031	.756	.630	.059	.074	.066	64.2	12.1	7.4	
Nov. 14.....	13 31	4.22	0.855	.670	.545	.058	.075	.066	53.6	10.4	5.1	P <sub>a</sub> ; T <sub>m</sub> aloft.
3:22 p. m.....	13 31	4.22	0.855	.670	.545	.058	.075	.066	53.6	10.4	5.1	
Nov. 19.....	25 31	2.32	1.345	.908	.748	.025	.075	.050	72.0	4.3	2.8	N <sub>ra</sub>
0:06 p. m.....	28 24	2.10	1.205	.824	.680	.057	.103	.080	68.1	7.4	5.1	N <sub>ra</sub> aloft.
Nov. 31.....	15 07	3.74	1.078	.779	.660	.089	.070	.054	58.9	4.7	2.4	N <sub>ra</sub>
0:44 a. m.....	27 08	2.14	1.090	.895	.675	.113	.156	.134	56.9	22.1	1.4	
2:52 p. m.....	16 22	3.51	0.770	.575	.505	.106	.161	.134	43.4	4.6	2.5	
Nov. 25.....	11 13	5.03	1.181	.864	.712	---	---	---	66.7	4.4	P <sub>c</sub>	
0:59 a. m.....	25 24	2.33	1.421	.974	.794	.016	.042	.029	78.0	11.2	5.6	
2:12 p. m.....	19 31	3.98	1.195	.850	.703	.039	.061	.050	77.2	---	---	
Nov. 26.....	22 38	2.59	1.056	.770	.691	.073	.083	.078	64.8	11.6	7.2	N <sub>ra</sub>
0:58 a. m.....	28 29	2.24	1.100	.800	.610	.060	.027	.044	63.2	8.0	5.4	
2:10 p. m.....	20 12	2.88	0.835	.615	.525	.108	.149	.128	52.5	10.4	6.1	N <sub>ra</sub> aloft.
Nov. 27.....	21 34	2.70	1.225	.874	.705	.036	.044	.040	71.5	10.0	6.1	N <sub>ra</sub>
1:21 a. m.....	24 01	2.37	1.225	.835	.700	.050	.105	.078	65.6	4.1	2.7	
Nov. 28.....	13 49	4.25	1.080	.798	.640	.045	.008	.026	76.1	12.0	5.8	N <sub>ra</sub> a. m.
Nov. 29.....	27 28	2.16	1.065	.785	.672	.131	.153	.144	64.6	11.2	7.6	P <sub>c</sub> p. m.
1:10 a. m.....	27 28	2.16	1.065	.785	.672	.131	.153	.144	64.6	11.2	7.6	P <sub>c</sub> ; P <sub>r</sub> aloft.

Atmospheric conditions during solar-radiation measurements, Blue Hill Observatory  
of Harvard University

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR  
NOVEMBER 1935

Date and time from apparent noon	Air temperature	Wind, Beaufort scale	Visibility (scale 0-10)	Sky-blue ness	Cloudiness and remarks
November 1935	° C.				
3; 2:17 a. m.	10.0	NNE 4	9	4	T St Cu.
3; 0:22 a. m.	10.6	NNE 5	9	4	T St Cu.
3; 3:11 p. m.	8.6	NNNE 3	9	6	T St Cu light water haze.
4; 0:07 p. m.	14.3	S 3	8	7	1 Ci, few ACu.
8; 0:35 a. m.	8.9	NW 3	7	9	1 ACu, 1 STCu, 1 FrCu.
8; 0:44 p. m.	10.0	NNW 3	8	9	3 Cu.
9; 2:23 a. m.	4.1	NW 2	7	7	1 Ci (in N) heavy haze.
9; 0:06 p. m.	7.5	EWS 3	8	8	T Ci, Cu (in N and E).
9; 0:38 p. m.	7.6	ESE 3	8	8	1 Ci, Cu.
19; 1:07 a. m.	3.8	N 2	9	8	Mod. haze to N and NE.
19; 2:07 p. m.	6.1	N 1	9	8	3 Ci mod. haze to N.
21; 2:24 a. m.	5.4	NW 3	7	7	Few ACu. Heavy haze to N.
25; 1:39 a. m.	4.4	NNW 5	8	8	1 Ci. Mod. haze N and E.
26; 1:12 a. m.	3.3	WNW 4	7	8	3 ACu. Mod. haze & water haze.
27; 1:08 a. m.	5.3	NW 1	7	7	2 Ci, few ACu, few Cu, mod. heavy haze.

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy, Superintendent, U. S. Naval Observatory. Data furnished by the U. S. Naval Observatory in cooperation with Harvard and Mount Wilson Observatories. The difference in longitude is measured from the central meridian, positive west. The north latitude is positive. Areas are corrected for foreshortening and are expressed in millions of the sun's visible hemisphere. The total area for each day includes spots and groups]

NOTE.—Owing to the fact that this report had not been received at the time of going to press, the November data will be published in the next (December) issue of the REVIEW.—Editor.

[Dependent alone on observations at Zurich and its station at Arosa]

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

November 1935	Relative numbers	November 1935	Relative numbers	November 1935	Relative numbers
1	<i>Ec</i> 22	11	<i>Ecd</i> 68	21	71
2	17	12	58	22	b 52
3	<i>Ecd</i> 42	13	<i>abd</i> 97	23	65
4	<i>aa</i> 46	14	<i>Ec</i> 98	24	45
5	46	15	117	25	44
6	41	16	110	26	<i>Mcd</i> 56
7	<i>d</i> 59	17	<i>Eac</i> ---	27	a 58
8	59	18	<i>a</i> 94	28	58
9	<i>b</i> 67	19	91	29	64
10	61	20	70	30	56

Mean 29 days = 63.4

*a* = Passage of an average-sized group through the central meridian.

*b* = Passage of a large group or spot through the central meridian.

*c* = New formation of a center of activity: E, on the eastern part of the sun's disk;

W, on the western part; M, in the central circle zone.

*d* = Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE, in charge]

By L. T. SAMUELS

At those few stations with a sufficient period of record for the determination of approximate normals, upper-air temperatures during November averaged above normal except at Omaha and San Diego and in the lower levels at Seattle, where the departures were negative. However, only seven observations were made at the latter station during the month and therefore the means are not reliable. (See table 1.) Upper-air relative humidity departures were positive except at Pensacola and Seattle where they were negative.

The directions of the upper-air wind resultants for November were in nearly all cases close to normal. (See table 2.) A few marked exceptions occurred; e. g., the upper levels at Seattle and Murfreesboro had a pronounced northerly component as compared to normal. Resultant velocities were below normal except over the more southern sections of the country where they were above normal. In nearly all cases the resultant velocity departures were of only moderate magnitude.